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54 Improvements in or relating to safety fences.

57 A tensioned wire cable safety fence in which two lower cables (17,18) are interwoven through a row of posts (6,7,8), one cable (17) passing the posts on the opposite sides to the other cable (18). The lower cables are tensioned after interweaving. Upper cables (15,16) are positioned in slots formed in the top of each post (6,7,8) and tensioned.

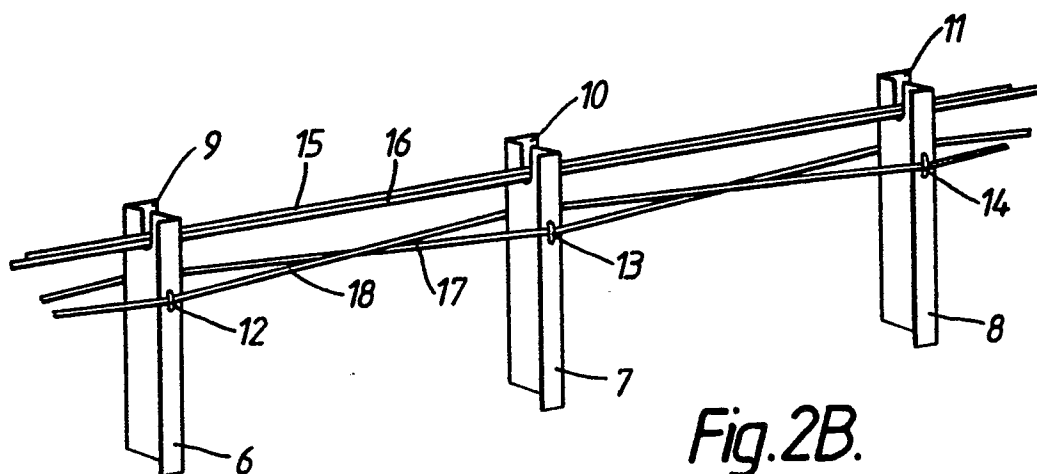


Fig. 2B.

IMPROVEMENTS IN OR RELATING TO SAFETY FENCES

This invention relates to safety fences designed to redirect or prevent passage of vehicles over prohibited ground and is particularly, but not exclusively, applicable to safety fences used on the sides of roads or central reservations of high-speed carriageways, roads or motorways, or embankments.

It is known that safety fences are available consisting of a number of spaced upright posts to which are clamped a number of tensioned horizontal wire ropes. It has been found that these known wire rope fences may be satisfactory when a vehicle approaches a fence at a relatively large angle of impact exceeding 20° whereas at small angles of impact below approximately 10° the vehicle may tend to spin or roll off the fence with consequent danger to the occupants of the vehicle. It is believed that one of the factors contributing to this hazard is the fact that the ropes are normally clamped to the steel posts by means of 'U' bolts or other heavy attachment devices which are strong enough to withstand the collision loading.

The disadvantage of clamping wire ropes to posts is overcome by the invention described in UK Patent No. 1,103,873 in which the tension cables are positioned as a slack fit in vertical slots in posts fixed into the ground. Tensioned cables act as a continuous beam to redirect a colliding vehicle smoothly back on to the roadway.

UK Patent 1,103,873 provides for a plurality of ropes supported either in slots in the top of the post or supported in brackets on either side of the post such that the cables are parallel to each other.

The testing of safety fence constructions in accordance with this patent has shown that the penetration is greater than that permitted in certain circumstances. It has also been shown that the release of the cables from the slots, whether in the posts or in the brackets, caused by the post deflection, may give rise to a situation that the cables are released too quickly or too far ahead of an impact point. This led to cables going slack too far ahead of impact and insufficient restraint for the vehicle and a danger that the vehicle will run over cable or cables lying on the ground.

The post for all the wire rope fences previously referred to have a main web and at least one flange with a cross-section, such as an 'I' section, with the main web of the section extending transversely in the direction of the cables. The post therefore has its weak axis in the direction of the fence, such that it can be more easily run down.

It is believed that the correct juxtaposition of tension cables and posts in the wire rope safety fence according to the invention met the objectives

and the tests laid down by the Ministry of Transport at that time. For over 16 years such a wire rope safety fence has been used on the Pennine section of the M62 motorway and has proved to have had considerable advantages over standard type central reservation barriers, in particular they have prevented build-up of drifting snow.

It is an object of the present invention to overcome the disadvantages of the cable safety fence system described in UK Patent No. 1,103,873 to produce better control of the action of a vehicle during impact.

Applicant's co-pending application of the same filing date relates to an alternative cable safety fence system which may be equally advantageous depending on circumstances and differing legal requirements laid down by the authorities.

According to one aspect of the present invention a cable safety fence comprises at least one upper cable held in tension and supported by a number of posts, the posts being such to permit the upper cable to be detached from its associated post under impact, and a pair of lower cables held in tension passing around the opposite sides of selected posts whereby the lower pair of cables is also detached from the post on impact by the vehicle as the post is bent to the ground subsequent to the release of the upper cables.

Location means may be provided on each side of the post for the lower cables permitting relative motion between the posts and the cables. These locating means may be grooves formed in the post or other suitable abutments, rings or hooks.

All cables are anchored to a suitable anchoring point and tensioned to between 1,000 and 5,000 KgF. The height of the ropes above the carriageway shall be for the lower crossed ropes 450mm to 500mm and determined by the position of the said location means, and for the upper ropes 575mm to 615mm, the preferred height being 495mm and 585mm respectively.

A preferred method of erecting a tensioned wire cable safety fence comprises drawing a first wire cable off a reel, weaving said cable between the posts, drawing from a second reel further wire cable and weaving said further cable between the posts so that the lower cables cross each other intermediate each post, drawing from a third reel further wire cable and placing the cable in slots in the top of erected posts above the said in tension cables, and finally tethering all the cables to the ground and applying tension to the free end of the ropes.

According to yet another feature of the invention, a cable safety fence may have adjacent cable

ends between posts spaced apart for vehicle access, joined by a quick-release mechanism between posts so as to provide road access through the barriers for emergencies, for example.

In another embodiment according to the invention, a corrugated tensioned beam barrier may incorporate a section or a continuation of cable safety fence anchored at one end to an end of a conventional beam barrier and tensioned. Such a corrugated tensioned beam barrier and wire rope barrier system may be provided to contain an existing corrugated beam barrier which has been damaged or to extend permanently an existing corrugated beam carrier with the improved wire rope safety fence, or to provide a safety fence in a gap in the existing corrugated beam carrier.

The posts are preferably of 'S' or 'Z' section such that the rounded corner is offered to the direction of the traffic. Such a design of post permits bending along the weaker axis, but does not provide solid restriction when a vehicle impacts the fence at 90°, since the post will twist slightly and bend on the preferred weak axis.

The posts may be located in the ground either as a driven post, i.e. a post having a plate welded to its lower section to prevent over-turning on impact, or a concrete footing which prevents over-turning of the post and allows the post to bend during impact.

The concrete footing may either be of a pre-cast design having an internal socket or opening to receive the post and thus to enable the height of the post to be set accurately on installation. Such preformed footings overcome the problem of soft ground and the difficulty of ensuring that the post is installed properly to the right depth and with the required strength of the concrete infill. In addition, when it is necessary to replace the posts because of vehicle impact, the impacted posts can be readily withdrawn and the replacement posts inserted immediately, thus facilitating re-erection of the damaged barrier in a very short period of time.

Due to the design of the safety fence, one fence on the central reservation will serve both carriageways. After an impact, repair is speedy and economic requiring damaged supports to be removed and new ones inserted, the wire ropes being re-located and possibly re-tensioned, but not necessarily replaced. Repair work could be carried out from either carriageway.

In another embodiment according to the invention, a known corrugated tensioned beam barrier may be incorporated within, or parallel with, or be a continuation of, a wire rope safety fence, such that the wire ropes can be attached to the conventional beam barrier. This may also be provided to contain deflection around existing road furniture on the central reservation in which must be protected by a

barrier of less deflection than the wire rope safety fence. Such a combined beam wire rope system may provide a wire rope safety fence as a first or additional barrier to be encountered by a vehicle before the corrugated beam barrier is encountered.

The posts may be of 'S' or 'Z' section and may be formed from pressed sheet steel of a thickness between 3mm and 7mm and adapt to deflect or distort under impact from a vehicle. The bending moment at yield of the post should be less than 6,000 Nm in its weakest plane.

The invention may be performed in various ways and a number of possible embodiments will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows a cable support post disclosed in UK Patent No. 1,103,873;

Figure 2 shows a 4-cable safety fence with the lower cables woven between the posts;

Figure 3 shows diagrammatically the method of weaving the lower cables around the erected posts;

Figure 4 shows typical pre-cast footings for the posts;

Figure 5 shows a quick-release system to provide emergency access;

Figure 6 shows a cable safety fence system attached at one end to a known corrugated tension beam barrier, and

Figure 7 which shows how a cable safety fence may be used in parallel or as a first barrier with a corrugated tension beam barrier forming a second or final barrier.

As will be seen from Figure 1, the cable supporting post 1 has a slot 2 in the top thereof; an upper cable 3 is indicated in position at the bottom of the slot 2. A lower cable 4 is positioned at the bottom of a slot formed in a bracket 5 attached to the post 1.

The upper rope 3 and the lower rope 4 are parallel to each other and with this form of cable support, the deflection of the fence under impact is greater than now required by the Ministry of Transport. In addition, bending of the post caused by impact may release the lower and upper cables from their respective slots more or less simultaneously and thus lead to the cables being released too quickly or too far ahead from the impact point 6 causing lowering of the cable, reducing restraint further ahead and increasing the likelihood of vehicles passing over the cables.

Figures 2 and 3 relate to the present invention. A number of posts are inserted into the ground (not shown) either into recesses in pre-cast footings or by any other suitable means. Suitable pre-cast footings are shown in Figure 4. Other post retention means to be inserted into the ground may be used, for example, cast or pressed steel hollow tube-like

structures, having a plate welded to its lower end to prevent overturning on impact, are alternatives but are not illustrated and nor described.

The posts 6, 7 and 8 have respectively slots 9, 10 and 11 formed in their upper ends. The slots are parallel-sided slots and parallel to the longitudinal edges of the posts. Location means 12, 13 and 14 are attached to the posts. Similar location means on the other side of the posts are provided but not illustrated. Two wire ropes 15 and 16 placed on top of one another are placed in position into slots 9, 10 and 11 and anchored to the ground and tensioned, as will be described in more detail with reference to Figure 3. The posts 6, 7 and 8 are made from steel pressings and have an 'S' or 'Z' cross-section such that a rounded corner on the line of the bend is offered to the direction of the traffic and not a sharp edge. Such a design of post permits bending along the weak axis but does not involve a solid restriction in when a vehicle hits the post at 90° since the post will twist slightly and bend on the preferred weak axis.

Lower ropes 17 and 18 are woven through the posts such that the lower ropes cross as indicated at 20. Depending upon the requirements for the fence, the lower cables may not cross between each pair of posts but, for example, every two posts or every three posts. Generally speaking, crossing before and after each post provides better restraint and delays the release of the lower cables from the post until after the initial bending of the post by impact has released the upper ropes. This delay may be very significant in providing maximum restraint while limiting damage to the vehicle.

Figure 3 shows very diagrammatically the posts 9, 10 and 11 and the lower cables 17 and 18. Cable 18 is drawn off drum 21 so as to pass the side of the post 9 before crossing over to the opposite side of post 10 and then again to the opposite side of post 11. Cable 17 is drawn off the drum 22, passes along the opposite side of post 9 as compared with cable 18, and so on in sequence, so that the cables cross as indicated at 20.

The height of the ropes above the carriageway are, for the lower ropes between 450mm and 500mm, and for the upper ropes between 575mm and 615mm which, it is believed, will be suitable for restraining a typically mixed traffic flow associated with motorways. The height of the lower cables is controlled by abutments, grooves or hooks attached to the sides of the posts and are arranged so that the cable can slide along the edge of the post when positioning the ropes and when tensioning.

Figure 4 shows cross-sections of suitable pre-cast footings which are suitable for wire cable safety fences and enable quick replacement of damaged posts. Furthermore, as compared with

the posts used for tensioned beam barrier posts for cable wire fences according to the present invention, require bending above ground on impact. Posts for corrugated tensioned beam barriers are often just driven into soft ground since no bending is required on impact with the beam barrier which is just pulled out of the ground and/or fractured by impact.

Figure 5 shows a typical quick-release mechanism which can be utilised to join all four of the cables in a 4-wire system such that they can be disconnected to provide easy access in the case of accidents.

Figure 6 shows how a wire rope fencing system may be attached to the ends of a corrugated tensioned beam barrier 26. This enables replacement of a tensioned beam barrier when damaged or extensions of motorway where it has been decided to take advantage of the tensioned wire cable safety fence without incurring the costs of replacing the tensioned beam barrier already in place.

Figure 7 shows how a tensioned wire cable safety fence 27 may be placed in parallel with a tensioned beam barrier 28 so that vehicles leaving the carriageway into the central reservation will first be restrained by the cable safety fence and secondly by the final barrier formed by the tensioned beam barrier. In a similar manner, wire cable safety fences may be positioned to restrain vehicles from other road furniture, lighting and road signs, for example.

All four ropes are anchored to a suitable anchoring point and tensioned between 1,000 and 5,000 KgF. This is not described in detail and is similar to the wire rope safety fence system in UK Patent No. 1,103,873.

The manner in which the ropes are anchored, how the anchorages are staggered along the length of the fence and how the cables are restrained by tethering wires when they are severed, is well known from the practice of wire fences that are already in use.

Claims

1. A cable safety fence of the kind comprising cables (15,16,17,18) supported in a number of posts (6,7,8) characterized in that the cables include an upper cable held in tension, the posts (6,7,8) being such as to permit the upper cable (15,16) to be separated from support from one post (6,7,8) under impact, a pair of lower cables (17,18) being held in tension passing around the opposite sides of selected posts whereby the lower pair of cables (17,18) is also detached from the one post (6,7,8) on impact by the vehicle as the one post (6,7,8) is bent to the ground subsequent to the

release of the at least one upper cable (15,16) from that one post (6,7,8).

2. A cable safety fence as claimed in claim 1 characterized in that there are two upper cables (15,16).

3. A cable safety fence as claimed in claims 1 or 2 characterized in that the lower cables (7,8) pass round the opposite sides of each post (6,7,8).

4. A cable safety fence according to claims 1 or 2 characterized in that the adjacent cable ends between posts are spaced apart for vehicle access and joined by a quick-release mechanism (Figure 5) between posts (6,7,8) so as to provide road access through the barriers for emergencies.

5. A cable safety fence as claimed in any of the preceding claims characterized in that the cables (15,16,17,18) are anchored at one end to a corrugated beam barrier (26).

6. A cable safety fence as claimed in any of the preceding claims characterized in that the posts (6,7,8) are of 'S' or 'Z' section such that the rounded corner is offered to the direction of the traffic.

7. A cable safety fence as claimed in any of the preceding claims characterized in that each post (6,7,8) has a plate welded to its lower section to prevent over-turning on impact.

8. A cable safety fence as claimed in any of claims 1 to 7 characterized in that each post (6,7,8) has a concrete footing (Figure 4) which allows the post to bend during impact.

9. A cable safety fence as claimed in claim 8 characterized in that the concrete footing is precast and has an internal socket or opening to receive the post and thus to enable the height of the post to be set accurately on installation.

10. A cable safety fence as claimed in any of the preceding claims and arranged in parallel with a corrugated tensioned beam barrier (28) whereby the cable safety fence (27) forms a first barrier and the corrugated tensioned beam barrier (28) a second barrier.

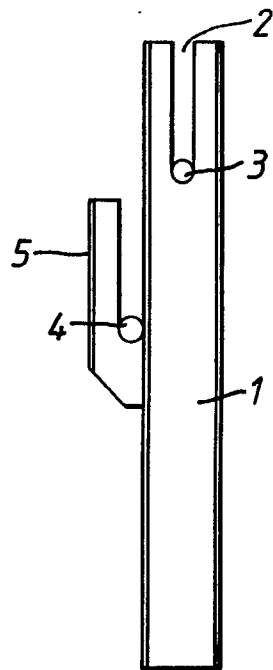
11. A cable safety fence as claimed in any of claims 1 to 10 characterized in that the upper cable or cables (15,16) is set at a height of between 575 mm and 615 mm and the lower cables (17,18) are set at a height of between 450 mm and 500 mm.

12. A cable safety fence as claimed in any preceding claim characterized in that all cables (15,16,17,18) are tensioned to between 1,000 and 5,000 Kgf.

13. A cable safety fence as claimed in any of claims 1 to 12 wherein the posts are provided with location means to determine the height of the lower cables.

14. A method of erecting a tensioned wire cable safety fence of the kind comprising at least one upper and lower cables (15,16,17,18) held in

tension and supported by a number of posts (9,10,11), the cables being drawn off reels and linked to said posts, characterized in that a first lower cable (17) is drawn off a reel (22) and is woven between the posts (9,10,11), a second lower cable (18) being drawn from a second reel (21) and being woven between the posts (9,10,11) so that the lower cables (17,18) cross each other intermediate adjacent posts (9,10,11), at least one upper cable being drawn from a third reel and placed in slots in tops of the posts (9,10,11) above the lower cables (17,18), the cables then being tethered and tensioned so that the lower ropes are drawn tightly around both sides of the posts (9,10,11).



PRIOR ART

Fig.1.

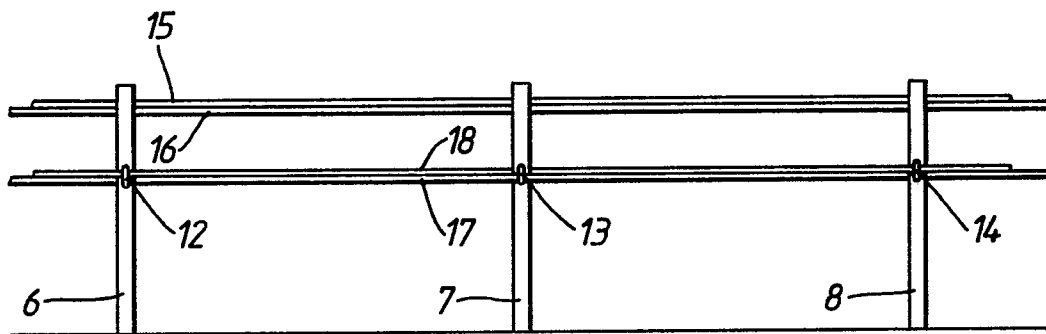


Fig.2A.

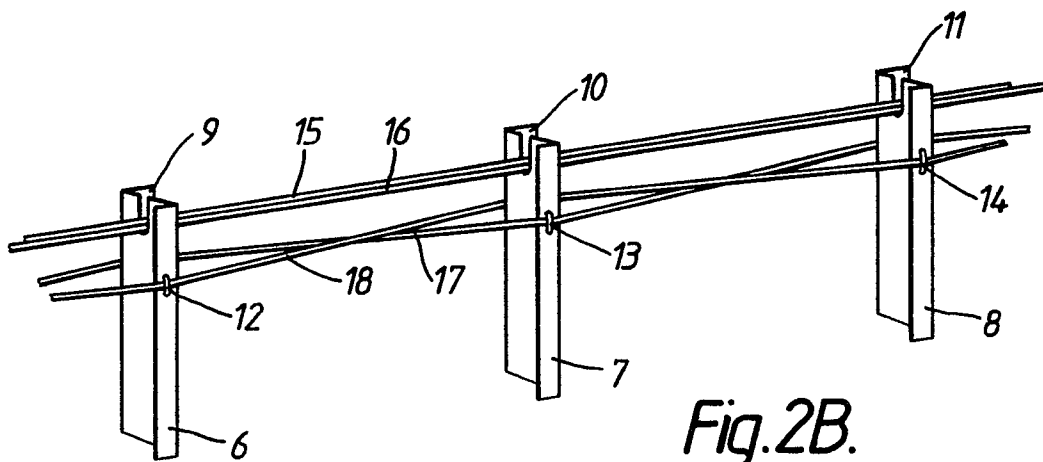


Fig.2B.

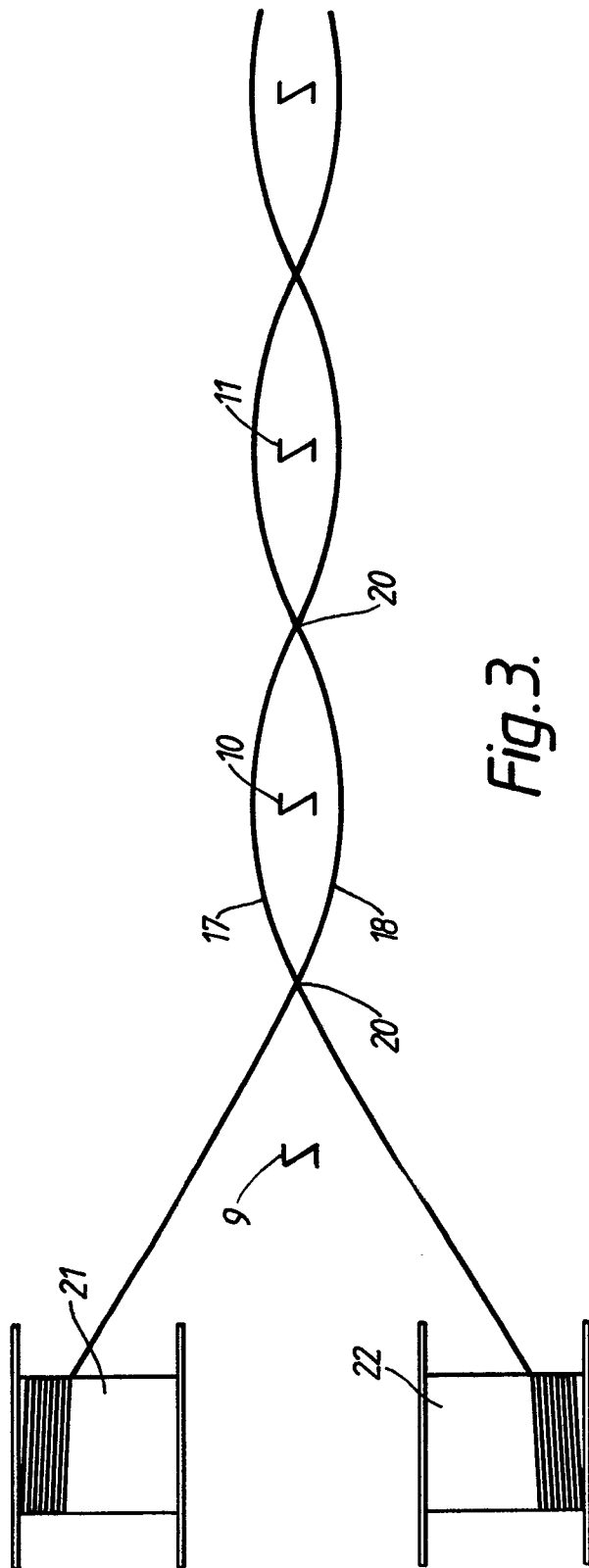


Fig. 3.

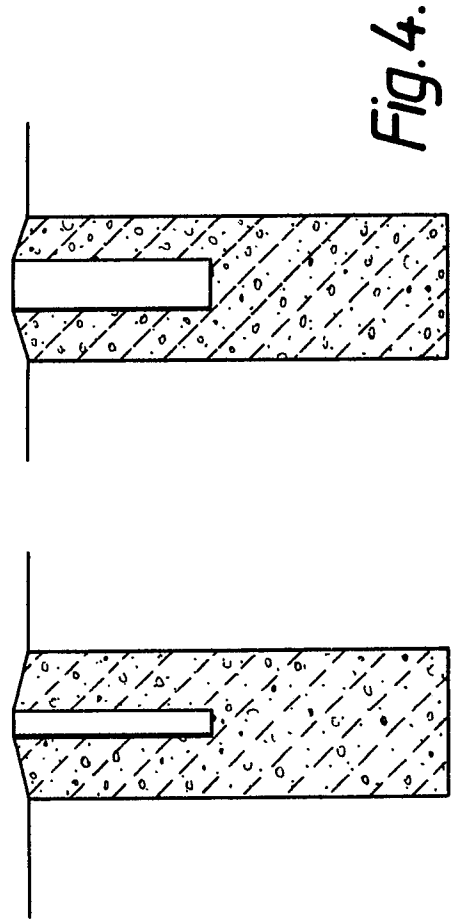


Fig. 4.

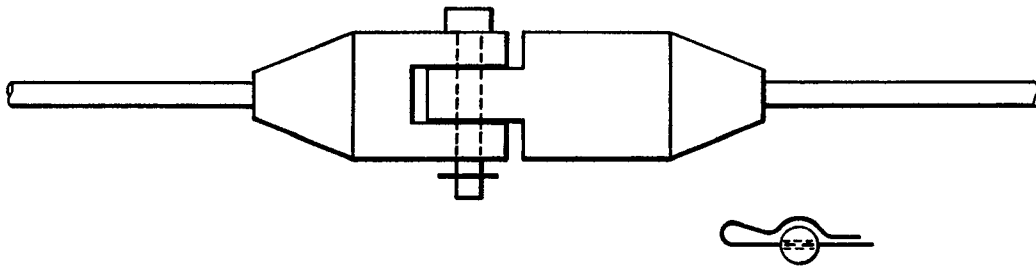


Fig. 5.

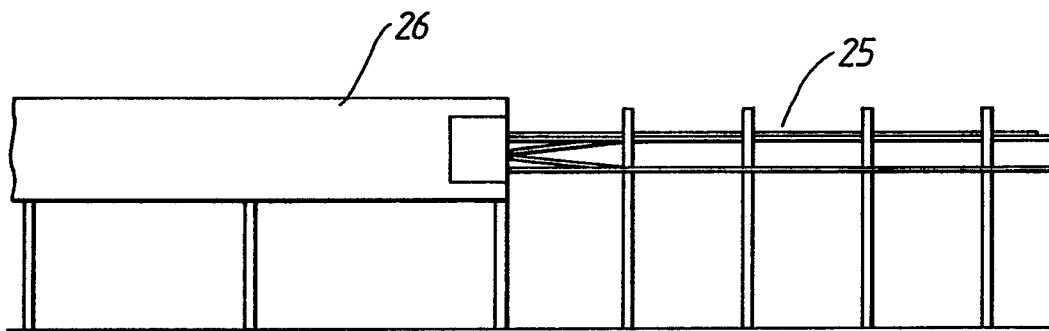


Fig. 6.

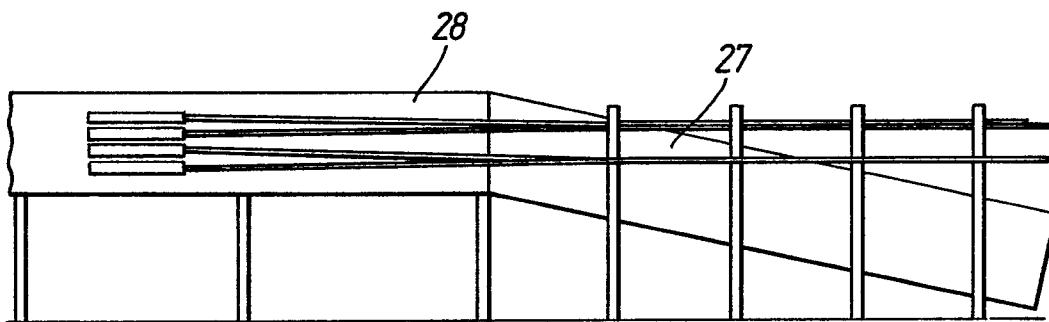


Fig. 7.



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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-1 012 212 (BRITISH ROPES) * Page 1, lines 8-11,19-26,31-37,48-56,73,74,77-79,82; page 2, lines 1,2,30-38,41-47,69-71,79-86,96-100,126-1 29; page 3, lines 4-6,18-21,24-28,34,35,42-44,47-49; claims 1,5,7-9,11,13; figures 2,4,6,7,11,12 *	1-3,8,9 ,11,13, 14	E 01 F 15/00
A	---	5	
Y	GB-A-1 120 959 (TREFILERIES LEON BEKAERT) * Page 1, lines 9-17,35-46,50-66,87,88; page 2, lines 1,2,11-15,20-28,56-59,64-67,76,77,99-120 ,124-130; figures 1,4,8 *	1-3,8,9 ,11,13, 14	
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A	NL-A- 291 261 (JONGE POERINK) * Page 3, lines 11-16,20-22; page 4, lines 5-8,22- page 5, line 4; claims 1,2,11; figures 1,2 *	1-4,13, 14	E 01 F

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12-02-1990	Examiner SCHUMAN R.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



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A	--- US-A-2 117 701 (BURNETT) * Page 1, right-hand column, lines 14-20,51,52; page 2, left-hand column, lines 21-23,27-29; figure 2 *	4	
A	--- US-A-2 157 227 (BRICKMAN et al.) * Page 1, lines 1-6,17-19,36-40, right-hand column, lines 3-8; figure 1 *	4	
A	--- GB-A- 463 509 (BELSHER) * Page 2, lines 113-116; page 3, lines 1,2,5-10,13-22,25-27; figure 1 *	4	
A	--- US-A-3 845 936 (BOEDECKER, Jr. et al.) * Column 6, lines 56-64; column 7, lines 65-67; column 7, lines 1-3,21-28; figures 8A,9,10,14,15-17 *	5,10	
A	--- US-A-2 979 307 (CRONE) * Column 1, lines 45-56,64-67; column 2, lins 25-34; figure 5 *	6	
A	--- GB-A-1 299 081 (PEARSON) * Page 1, lines 31-33,39-42,56-58,84-92; figures 1-5 * --- -/-	6	
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A	US-A-2 942 853 (GLAROS) * Column 1, lines 46-52; column 2, lines 12-18,39-41; figure 3 * ---	6													
A	US-A-3 314 658 (SHOEMAKER) * Column 1, lines 22-32; column 3, lines 19-23; column 4, lines 15-21; figures 1,12,13 * ---	7,8													
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A	US-A-3 705 709 (ANDRIUSSI) * Column 5, lines 48-56,61,62; column 6, lines 15-19,21-23,33-50; figure 8 * --- -/-	10	TECHNICAL FIELDS SEARCHED (Int. Cl.5)												
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A	US-A-1 930 985 (SCHULZ) ---		
A	US-A-2 317 248 (BRICKMAN) ---		
A	US-A-2 005 418 (GLEASON) ---		
A	CH-A- 419 214 (GEBR. GYSI) -----		
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